Translation

PATENT COOPERATION TREATY

PCT/EP2003/005068

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P26600/WO Kf/dav	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP2003/005068	International filing date (*day/month/year*) 14 May 2003 (14.05.2003)	Priority date (*day/month/year*) 24 June 2002 (24.06.2002)
International Patent Classification (IPC) or national classification and IPC H04L 27/26		
Applicant ROHDE & SCHWARZ GMBH & CO. KG		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25 August 2003 (25.08.2003)	14 January 2004 (14.01.2004)
Name and mailing address of the IPEA/EP Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/EP2003/005068

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:

pages 1-12, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☒ the claims:

pages _____, as originally filed

pages _____, as amended (together with any statement under Article 19

pages _____, filed with the demand

pages 1-28, filed with the letter of 05 November 2003 (05.11.2003)

☒ the drawings:

pages 1/2-2/2, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☐ the sequence listing part of the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-28	YES
	Claims		NO
Inventive step (IS)	Claims	1-28	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-28	YES
	Claims		NO

2. Citations and explanations

1. According to its title, the international application PCT/EP03/05068 concerns a method for equalising and demodulating a data signal transmitted via a time-variant channel. Claim 1 defines the method steps required.

2. The **prior art** is acknowledged by the applicant in the description (see in particular pages 1 and 2, up to line 22) and is shown in the preamble of claim 1. The international search report citations that are considered relevant are **D1** and **D2**:

D1: DIGGAVI S ET AL: 'Intercarrier interference in MIMO OFDM' 2002 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, CONFERENCE PROCEEDINGS. ICC 2002 (CAT. NO.02CH37333), PROCEEDINGS OF IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, NEW YORK, NY, USA, 28 APRIL-2 MAY 2002, pages 485-489, vol. 1, XP010589542 2002, Piscataway, NJ, USA, IEEE, USA ISBN: 0-7803-7400-2

D2: US-B1-6 320 919 (FULGHUM TRACY ET AL) 20 November 2001 (2001-11-20)

D1 examines the behaviour of the system during multicarrier transmission, in particular for OFDM,

via time-variant channels. In particular, the influence of the time variation within a transmission block is analysed, it being possible for this time variation to be caused by Doppler propagation in the channel (e.g. owing to the "high-mobility application") or also by synchronisation errors. The negative effects resulting therefrom are interchannel interference (ICI) and intersymbol interference (ISI). D1 proposes that filter-supported ICI attenuation techniques be used in the time range, the time-variant channel being in addition cascaded with a receive filter such that the channel as a whole is largely time-independent.

D2 relates to the characterisation of the channel response in digital mobile radio systems. In such systems, the signals are often reflected, scattered, diffracted, delayed and attenuated by the environment. Furthermore, the environment for the radio signal is not stationary, on account of the mobility of the user. D2 aims to indicate a method which characterises the propagation of the modulated signal and the channel of the mobile radio system which responds to alterations in the propagation. To this end, D2 uses a multi-pass demodulation in which, during the second pass, already decoded symbols are re-encoded, treated as known symbols and used to calculate the error coefficient for use in updating the characterisation of the propagation. The propagation can be characterised via a channel tracker or a multiple antenna receiver. With regard to the channel tracker, D2 discloses the use of, e.g., LMS-type or Kalman-type trackers.

The disadvantage of the prior art is that

conventional methods for channel estimation and equalisation are based on an estimation of the channel impulse response as a time function or in the spectral range. This channel impulse response is estimated using training sequences and the basic channel model. The estimation method and the channel models cannot take into account the geometry of the scatterers which cause the distortion. In multicarrier methods (e.g. OFDM), a real channel has a plurality of paths with different Doppler shifts which a conventional method with the direct estimation of the channel via its channel impulse response cannot replicate. A common assumption with respect to the alteration of the channel over time is that, between the training sequences, the impulse response alters only slightly or only deterministically. It is therefore implicitly assumed that the channel is constant on a OFDM block. However, this constancy on a block is not achieved in multicarrier methods, and the accuracy of the method suffers as a result.

3. The **problem addressed by the invention** (cf. page 2, lines 24 to 29) is that of producing a method for equalising and demodulating a data signal that is transmitted via such a time-variant transmission channel so as to avoid these disadvantages and limitations with respect to the properties of the channel.

4. The problem addressed by the invention is solved by the advantageous interaction of the technical features indicated in claim 1.

Claim 1 reads:

Method for equalising and demodulating a data signal that is transmitted to a receiver via a time-variant channel according to a single carrier or multicarrier data transmission method,
characterised in that
in the receiver, from the data signal received, *the scattering coefficients* damping, delay and Doppler frequency are *determined for those scatterers* which cause the signal distortions in the channel,
and
the data signal is equalised and subsequently demodulated using the scattering coefficients thus obtained.

5. The method described in claim 1 contains advantageous effects, in particular with respect to reducing complexity, as is explained on page 10 (line 17) to page 11 (line 14) of the description.

6. The totality of all the technical features of claim 1 is **not** disclosed by any one international search report citation. The subject matter of claim 1 therefore satisfies the criterion of novelty (PCT Article 33(1) and (2)).
The international search report citations do **not** render the subject matter of claim 1 obvious either. Consequently, the claimed subject matter meets the inventive step requirements (PCT Article 33(1) and (3)).
The subject matter of claim 1 is industrially applicable, *inter alia*, for data transmission methods with single carriers which have been modulated with PSK or QAM (cf. page 6, lines 1 to 10) or for DVB-T methods with multicarriers, for example OFDM (cf. page 6, lines 27 to 31).

Consequently, the industrial applicability requirements of PCT Article 33(1) and (4) are met.

7. Dependent claims 2 to 28 define special embodiments of the method according to claim 1, in particular how the scatterers and their scattering coefficients might be determined. These dependent claims therefore likewise satisfy the requirements of novelty, inventive step and industrial applicability (PCT Article 33(2) to (4)).

8. This international preliminary examination report is based on the assumption that all the claims enjoy the priority of the filing date of the priority document. Should this later prove not to be the case, the following document indicated in the international search report could become relevant:

D3: GLIGOREVIC S ET AL: 'A new approach to tracking time-variant channels' 5TH INTERNATINOAL SYMPOSIUM ON WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS. PROCEEDINGS (CAT. NO.02EX568), 5TH INTERNATIONAL SYMPOSIUM ON WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS, HONOLULU, HI, USA, **27-30 OCT. 2002**, pages 1342-1345, vol.3, XP002247193 2002, Piscataway, NJ, USA, IEEE, USA ISBN: 0-7803-7442-8.